

OBSERVATIONS ON THE TREATMENT OF FRACTURE OF THE NECK OF THE FEMUR IN  
112 CASES.\*

BY JOHN B. WALKER, M.D.,

OF NEW YORK,

Surgeon Bellevue Hospital; Lecturer on Surgery, Columbia University.

Since January 1st, 1906, there have been admitted to Bellevue Hospital, 378 cases of Fracture of the Femur, and of these, 112 were cases of Fracture of the Neck.

SEX. 53 cases occurred in males and 59 cases in females. 49 involved the right Femur and 58 the left Femur.

AGE. 9 cases occurred in patients under 30 years of age,

21	"	"	"	between 30 and 50	"
22	"	"	"	50	" 60 "
42	"	"	"	60	" 70 "
15	"	"	"	over 70	"

In 3 cases the age was not given.

Formerly it was regarded as a fracture occurring almost exclusively in old age. Koehler stated that he had observed it rarely before the age of 50. Our statistics show a large number occurring below the age of 50. This is probably due to the fact that all accident cases are now more frequently brought to hospitals for examination. The fact that its frequency increases with age is due to the senile changes of old age—senile osteo-porosis, which is caused by the diseases of the vascular walls. The cortex becomes thinner, many of the lamellæ of the spongiosa are absorbed, and are replaced by large cavities filled with yellow marrow. All the conditions, which formerly gave the neck its power and resistance are lost and more especially in women than in men, so this fracture occurs more frequently in women than in men, as above 59 cases in females and 53 cases in males.

CAUSE. In 51 cases the cause was due to slipping and fall-

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ing upon the floor or sidewalk, frequently due to a misstep. These cases were generally more than 60 years of age. In 28 cases it was due to falling from a ladder, scaffold or down stairs, requiring more force than in the first group.

In 18 cases it was due to a fall from some greater height; as from a loft, down an elevator, or from a fire escape, etc. These cases were all under 50 years of age.

Thus the most frequent cause was mild in character, and involved chiefly the old, while in the younger individuals greater violence was the rule. In many cases it stated that the patient fell directly upon the hip and that a contusion was found on this area, so that here direct violence was the cause. In several others, "that as he stumbled he tried to straighten up to prevent falling, he suffered severe pain in the hip and fell." The explanation of this indirect cause is that the hyper extension of the hip joint tightens the ilio-femoral ligament and the latter by reason of its greater strength tears the neck away from its base, the trochanter.

**SYMPTOMS.** Pain was present in every case, and was always increased when motion was made.

Loss of function was noted in 94 cases; in but few cases could the heel be partly drawn upward toward the hip.

**ANATOMY.** In consulting the records of the above cases, which were dictated at various times by different surgeons, a considerable variation of nomenclature was found. Some adhered to the old terms of intracapsular and extracapsular, others included both varieties of fractures under the single term of "Fracture of Neck"; others used Kocher's classification of *fractura subcapitalis* and *fractura intertrochanterica*.

The terms intracapsular and extracapsular are unscientific, inaccurate and misleading because the majority of cases do not fall distinctly into either group, for they are "mixed." Intracapsular cases were supposed to include all fractures in which lines were entirely within the capsule; extracapsular all those which were entirely without the capsule; but as the majority of fracture lines are oblique or diagonal and not strictly transverse, a fracture might be intracapsular in front and extra-

capsular behind, for the capsule is so arranged that it includes more of the joint in front and below than above and behind.

Kocher's terms while more strictly anatomical did not gain popular usage.

Stimson's classification has been followed; *i.e.*, fracture through the neck or subcapital, and fractures at the base of the neck. The neck is apt to break in one of two places, at its junction with the head, or at the base, its attachment to the trochanter.

Formerly it was considered of more importance to differentiate closely between these two fractures as if the fracture were intracapsular the prognosis would be far more unfavorable than if the fracture should be extracapsular, consequently less would be expected and the treatment might be less efficient.

Outward rotation was noted in 80 cases. If a line be drawn through the axis of the limb passing through the anterior superior spine and the tip of the great toe, the part of the limb lying to the outer side of this axis will be much heavier than the inner part. If now the normal support of the limb, the femoral neck be broken, the limb will naturally rotate outward by its own weight. When impaction occurs it will also be rotated outward, for the impaction takes place usually at the posterior portion of the neck and the trochanter is twisted backward.

Shortening was recorded in 70 cases.

In 3 cases  $\frac{1}{4}$  inch existed

10	"	$\frac{1}{2}$	"	"
22	"	$\frac{3}{4}$	"	"
20	"	1	"	"
15	"	$1\frac{1}{4}$ -2	"	

Shortening is the most important symptom and depends upon the lessening of the angle between the neck and the shaft, which approaches more to a right angle, upon impaction of the fragments or their displacement longitudinally. After the fracture occurs the strong muscles which are inserted about the trochanter contract and draw the trochanter upward, inward and

backward toward the crest of the ilium, until checked by the resistance of the untorn portion of the capsule or by the abutment of the lesser trochanter against the inner fragment.

If impaction occurs the lower portion of the neck may be forced into the spongiosa of the head; under these conditions shortening is not more than one inch. If the impaction is separated and the capsule yields, the shortening may become increased to several inches. This was observed in several cases where movements had been made, and the weight of the body had been borne upon the fracture.

Exact measurement is frequently difficult because it is so hard to keep both legs at the same angle with the pelvis; they should be parallel or equally abducted from the median line. The measurement should be taken from the anterior superior spine to the most prominent point on the internal malleolus.

Bryant's method was frequently used. It consists in dropping a perpendicular from the anterior superior spine and measuring the distance from this line, to the top of the trochanter and then comparing this with the other side.

A number of records merely stated that the trochanter was above Nelaton's line,—a line drawn from the anterior superior spine to the tuberosities of the ischium.

Crepitus was recorded in 40 cases, and was elicited when gently rotating the leg with slight flexion.

False motion was occasionally mentioned.

Impaction was seldom recorded,—in but six cases; when one considers the histories of the class of cases who enter Bellevue, the period of delay which frequently exists, it is not surprising that impaction seldom persists. That it was present at some time to some degree can be recognized from the X-ray plates. These were made in 36 cases. In 29 cases the fracture was at the base and impaction existed in 18 cases; in 6 cases the fracture was through the neck and impaction existed in one case.

**FULNESS IN SCARPA'S TRIANGLE.** Under normal conditions the finger tips can be pressed deeply into the outer portion of Scarpa's triangle, but in those cases in which there

has occurred a fracture of the neck a marked bony resistance is perceived on pressure. This is due to the fact that in the most common variety of fracture the head and neck are bent backward and downward, thus resulting in forcing the apex of the fractured angle upward and forward into the region beneath Scarpa's triangle. In a number of cases this has been a well marked symptom, but in a few cases has it been recorded.

As indicating the necessity for a more thorough early examination with the additional help of an X-ray plate, it may be remarked that there were 15 cases of fracture, which had been treated from 5 to 10 days before entering Bellevue, as bruises, sprains and rheumatism. Later careful examination demonstrated a fracture in each case.

**MORTALITY.** 10 patients died in Bellevue within the first week after admission,—5 of cardiac disease and 5 of pulmonary disease. The youngest who died in Bellevue was 58 years of age, and only two died under 60 years of age. Both were females. Seven patients, who were transferred to the island, died,—4 within two weeks, 3 within 6 weeks. Of these 18 who died within six months after the injury, 2 were between 50 and 60 years of age, 10 were between 60 and 70; 6 were over 70.

**RESULTS.** Of the 112 cases, 18 died; 32 have not been found (through moving from place to place); 30 are unable to work because of persistent impairment of function through pain; through restriction of movement at the hip on account of shortening and adduction; through the necessity of dependence upon crutches. Twenty-two show improvement. Twelve have abandoned their crutches and are walking comfortably with a cane, but at times with some stiffness and occasional pain. They are beginning to do some work. Ten have recovered almost completely; they are free from pain and stiffness, and are able to do their normal work. Ten are still in the hospital.

In searching through the histories and records of these cases it was interesting to learn that 34 cases or 30 per cent. had been brought to Bellevue from other hospitals after re-

maining in said hospital for less than one week. Furthermore of all the cases admitted to Bellevue, 54 cases or 50 per cent. were retransferred or discharged from Bellevue within fifteen days.

Considering that so many cases were accorded so brief and probably so unsatisfactory a treatment before being discharged or passed on to some other hospital, one might feel that there was some slight indifference to the future welfare of a patient suffering from fracture of the neck of the femur. One acute observer has written that "it may well be that treatment is perfunctory because the prognosis is bad and the prognosis is bad because the treatment is ineffective." There exists the general belief that definite treatment toward securing restoration of form and function is hazardous and of little avail. Authorities have stated that "our prognosis in cases of fracture of the neck must always be unfavorable," and also "if he escapes with his life he has to be contented with loss of function, loss of symmetry and equipoise, and he is often obliged to go about permanently crippled."

Scudder gives the following: "Results after Fracture of the Hip. Of especial value in this connection are the conditions existing in sixteen cases of fracture of the hip, many years after the accident. These sixteen cases were treated at the Massachusetts General Hospital by traction and immobilization, for periods varying from a few weeks to a few months. The patients then went about with crutches. No other treatment was used. Nearly all the cases were unimpacted either primarily or secondarily. At the time of the accident, seven cases were between forty-two and forty-seven years old, the remainder—with two exceptions, whose ages are not stated—were over fifty; three were over sixty years old. These cases reported for examination from two and one-half to twenty-four and one-half years after the accident. Thirteen of the sixteen cases have impairment of the functional usefulness of the leg; a weakness of the limb, necessitating a crutch in many instances; all movements at the hip somewhat restricted; atrophy of the muscles of the thigh, buttock, and calf of the leg;

a decided limp, requiring a cane; pain in the hip extending down the thigh even to the sole of the foot; pain at night in the hip; pain in going upstairs and in stooping over. In only two cases out of the sixteen could it be said that the leg was functionally useful."

These results are most unsatisfactory, and combined with the above similarly unfavorable results in Bellevue they explain somewhat the generally pessimistic views of the profession at large. In his latest volume an eminent authority writes,— "The attainment of the ideal object of treatment—restoration of form and function is rarely to be expected or *even sought*."

These unfavorable clinical results together with the opinions of the authorities quoted emphasize the words of Bardenheuer at the last German Surgical Congress when he stated the suitable treatment of fracture of the neck was the most difficult in the entire realm of fractures and also the one most unsatisfactorily treated.

Bardenheuer and Maxwell both have demonstrated that it was possible under their methods of combined lateral and longitudinal traction, to obtain better results than under the usual methods with side splint and longitudinal traction.

Appreciating the impossibility of obtaining success with the old time method and being unable to employ in Bellevue the apparatus of Bardenheuer I have used the method advocated by Whitman in 16 cases during the past 18 months.

Of these cases 5 were males and 11 were females. 9 cases were under 50 years of age; 3 were between 50 and 60; 4 were over 60. One was through the neck and not impacted; 12 were at the base, 7 were impacted. In 13 X-rays plates were made to corroborate the diagnosis.

METHOD. The following procedure was employed in the above cases. A careful examination was made of the patient's condition in order to determine the wisdom of giving an anaesthetic for a period of 20 minutes, this time being required for the application of the plaster bandage.

As soon as the anaesthetic permitted complete relaxation a gentle examination was made of the fracture, frequently

crepitus was found in those patients in whom impaction was thought to be present.

The patient was then lifted up from the table and placed upon a box or pillows about 8 inches high and large enough to support the head, shoulders and trunk. The pelvis rested upon a sacral support and the extended legs were held by assistants, one assistant holding each leg. Another assistant stood at the head to hold the patient by the shoulders and trunk when later extension became needed. The leg on the fractured side was then *gradually* abducted to the normal limit of about 45 degrees, the hip joint being held and supported by the hands of the operator. At the same time traction was being made to overcome the shortening by drawing down the leg as far as possible toward its original length as shown by previous measurements. The pelvis was prevented from tilting upward by simultaneously abducting the sound leg to 45 degrees, it thus serving to indicate approximately the angle at which the fractured leg should be fixed. Outward rotation is corrected at the same time by lifting up and supporting the upper end of the femur and rotating inward the leg.

The plaster spica was so applied as to include the pelvis and crossed below the edge of the ribs; this later permitted the patients to move about semi-reclining and to rise in bed without so much discomfort as when the bandage was carried up to the chest line. It was fitted closely about the pelvis, particularly about the trochanter and behind the articulation so as to give unyielding support to the fracture. Further the bandage was closely moulded about the patella and condyles of the femur and included the foot, thus preventing completely any outward rotation.

In order to render the plaster bandages as comfortable as possible folded cotton batting or sheet wadding was placed over all bony prominences and over this a flannel bandage, carefully adjusted, free from wrinkles or creases, avoiding all direct pressure over bony prominences. The plaster edges were trimmed and rounded so as not to come into contact with the skin.

**DIFFICULTIES.** It is difficult to apply the plaster bandage because it is necessary to have experienced assistants with sufficient strength to overcome the contractions of the strongly elastic muscles during the entire period required to apply the bandage, and it requires unusual steadiness and concentration of attention of the operator, and *each* of the three assistants to maintain the exact relation of the fragments; for unless the bandage be applied exactly it will be either inefficient to correct the displacement or uncomfortable for the patient.

In hospitals where there are many such fractures it would be advisable to have a table similar to that employed by Schede, upon which the patient can be satisfactorily held.

It was hard to make the proper abduction and at the same time to prevent shortening. It is very important to make abduction complete for as it exercises direct traction upon the capsule so it renders the capsule tense in front and below. As it supports the sides of the fragments it tends to force them into alignment, so it assists in correcting the malposition of the inner fragment and brings the two into contact.

In impacted fractures, passive abduction affords the most practical method of reducing the deformity without danger of widely separating the fragments.

In many of the unimproved patients it was found that their inability to walk without discomfort was due to a restriction of adduction. Adduction was marked and added an apparent to an actual shortening of the limb. It is very important to overcome the shortening which is almost always present in the majority of patients for this shortening is responsible for most of their later disability.

**ADVANTAGES.** It maintains complete immobilization during the period of repair, overcoming the shortening and adduction. The abduction prolonged during four weeks is of marked importance in aiding the future ability to walk without impairment or limitation of motion. It further relieves the patient from much unnecessary suffering on movement and renders him far more comfortable.

**TREATMENT.** The aim of the treatment should be the

restoration of the normal function of the hip joint and in order to accomplish this result the normal anatomical form must first be restored. The same principles which are necessary to produce success in the treatment of fractures in other situations must also be employed here. In another group of cases, which is fortunately small, the age and weakness of the patient are so marked that only such expectant or palliative treatment should be considered. It is not difficult for the surgeon to decide upon the conservative method in these cases. It is desired to suggest the plaster bandage method for the larger number of younger and more robust patients for whom our results would indicate it to be desirable and applicable.

As the chief point to be sought for is to endeavor to obtain the complete or approximate restitution of the normal anatomical configuration of the bone so it becomes necessary to overcome the displacements of the fragments. As we have no power at all over the proximal fragment so we must endeavor to bring the peripheral fragment, the peripheral portion of the femoral neck into the prolonged axis of the central fragment. The upper end of the distal fragment, the trochanter major is drawn upward by the action of the gluteals and rectus femoris in front; by the biceps, semitendinosus and semimembranosus behind; it thus becomes deviated upward, inward and backward (producing the shortening; the outward rotation is due to the mechanical weight of the leg, a result of gravity), hence it must be conducted forward, downward and outward. To accomplish this two forces are necessary, longitudinal and lateral traction. These have been used by Maxwell and Bardenheuer, and especially developed by Bardenheuer.

As has been shown, the larger number of fractures occur at the base and in most of these cases impaction is also present immediately after the injury. In many cases, however, this impaction is broken up and the fragments are separated when brought to the hospital,—especially Bellevue. In these unimpacted cases there has been no difference of opinion regarding the attempt to replace the fragments in their normal anatomical position. But in those cases in which impaction remains

there is a decided variance of opinion. It seems best after observing the good results obtained by Bardenheuer, Ochsner, Maxwell, Whitman and others to recommend that the deformity be reduced (while the patient is under the anæsthetic) by carefully separating, and unloocking, the fragments, not by tearing them asunder violently and harshly, but by carefully opening them as one would open a hinge.

Treatment should begin at once after the injury before the muscles have time to contract, and so displace the fragments. Each day's delay renders the reposition and reduction of the deformity so much the more difficult, and also permits the fragments to rub against each other, causing an increasing irritation which results in the production of an hypertrophic callus. Exact early reposition of the fragments decreases the amount of callus, and is indispensable for union in unimpacted fractures.

"At the present day our endeavor is not the production of so much callus, but rather as little callus as possible. When the fractured surfaces are in exact contact with each other along the entire extent nature does not need to supply much callus. Severe swelling about the fracture is always the expression of malposition of the fragments."

In Germany various surgeons, who have employed the extension method of Bardenhener with such excellent results, recommend it so highly that it should be used here when circumstances permit. It will require experienced assistants who must be interested in its successful outcome.

RESULTS.—CASE 1.—Male 45, moderately stout, aleoholic. Four days before admission he fell upon the left hip and was unable to move. He was brought to Bellevue, where a diagnosis of fracture at the base was made. There was  $\frac{3}{4}$  inch shortening and outward rotation existed. He was given an anæsthetic, when crepitus was easily found. A plaster bandage was applied including the foot. At the end of four weeks he was allowed out of bed on crutches. At the end of six weeks the plaster bandage was removed below the knee. At the end of eight weeks the entire bandage was removed and he went about on crutches, without any

pain. At the end of three months he was doing well, still using crutches. At the end of four months he had abandoned crutches and was using only a cane. At the end of nine months he was at work. At the end of twelve months he had but  $\frac{1}{4}$  inch shortening and was able to do his regular work as a mechanic. Sixteen months after the accident he is without pain or discomfort and has but  $\frac{1}{4}$  inch shortening; flexion and abduction are practically normal.

CASE 2.—Male 65, large frame, well nourished. Four days before admission he slipped and fell upon the sidewalk, striking his right hip. He was unable to move and was treated for a bruise for three days. He was transferred to Bellevue where a diagnosis of fracture at the base was made; there existed marked outward rotation and  $1\frac{1}{4}$  inches shortening. Crepitus was felt and fullness in Searpa's triangle. Under an anaesthetic a plaster bandage was applied. He was confined to bed for four weeks, then allowed to use crutches daily. At the end of eight weeks the entire bandage was removed but he was not permitted to bear any weight upon the injured hip until the fourth month. At the end of six months, he used a cane only at times and was able to do work as a janitor. At the end of nine months he was in good condition, he could walk well without pain, go up and down stairs, and there was less than half an inch shortening; flexion and abduction are normal.

CASE 3.—Female 47, large and fleshy. Two days before admission slipped and fell upon the sidewalk, striking upon the right hip. She was unable to move and could not stand when lifted up. On entering Bellevue a diagnosis of fracture at the base was made. There were present outward rotation, fullness in Searpa's triangle, crepitus, and  $\frac{1}{2}$  inch shortening. Under an anaesthetic a plaster bandage was applied. At the end of five weeks the bandage was removed below the knee. At the end of eight weeks it was entirely removed and she was about on crutches. During the sixth month she used only a cane. At the ninth month she was able to do her normal housework without discomfort. She has no perceptible shortening; flexion and abduction are normal.

CASE 4.—Male 17. Two days before admission he fell down an elevator shaft, a distance of about five stories. He was unconscious, but recovered within the next twenty-four hours. There was found to be a fracture at the base. Outward rotation, and

1½ inches shortening were present. Under an anaesthetic a plaster bandage was applied. At the end of three weeks the bandage was removed below the knee. At the end of four weeks he was out of bed using crutches. At the end of eight weeks he was using a cane. At the end of four months he was working on a farm. At the end of six months he was doing his regular work as a mechanic. At the end of one year there is but ¼ inch shortening, he walks with only a very slight limp, abduction and flexion are normal, and at no time has he any pain or discomfort.

The favorable results exhibited by these four patients at the end of six, nine and twelve months; the absence of deformity, pain and discomfort; the freedom of motion and their ability to resume their regular work, are undoubtedly due to the method of treatment employed.

Five other patients who have been under treatment for less than four months are up and walking on crutches. Six additional patients of less than two months' duration are not upon crutches. There is every reason to believe that the results in these cases will be as favorable as in those first reported.

In no case has it appeared that the patient was harmed by the application of this bandage. In no case did it produce pressure sloughs and require to be removed. In but a few early cases did it need to be cut away at the edges on account of injury to the skin. The plaster bandages were applied with great care and patience on the part of the House Staff to whose interest and effort much of the comfort of the patients were due. In a majority of the cases the plaster bandage was not applied until several days had elapsed after the injury. In six cases the patients had been under treatment in some other hospital before being transferred to Bellevue; four others had been treated at home for several days, and for other reasons this bandage was not at once applied. In only three cases was it put on within three days after the accident. Although the long side splints were in use, all these patients complained of pain whenever any movement was made—(in changing the sheets, in changing from one position to another, in lifting up to use the bed pan, etc.), the side splints did not

give sufficient support to prevent movement between the fragments.

However after the plaster bandage was applied the patients found they could move about without pain and could help themselves in many ways. The nurses appreciated the many advantages which the patients gained through the comfort of a well applied plaster bandage. In general the patients were far more comfortable than others with similar fractures but under the routine treatment with the long side splint and Buck's extension. From the hospital standpoint this method of treatment is less exacting in that the patients being more comfortable do not require so much time and attention from the nurses.

*Conclusions.*—1. Fracture of the neck of the Femur occurs under fifty years of age more frequently than was formerly believed.

2. Any injury to the hip followed by disability should suggest the possibility of a fracture of the neck, and requires an expert examination aided by an X-ray photograph.

3. Reduction of the deformity with complete immobilization of the fracture during the period of repair is advised by means of a plaster bandage in all suitable cases.

4. This is to be followed by *early* gymnastic movements, active rather than passive.

5. All weight bearing upon the fracture is to be avoided for from three to four months.